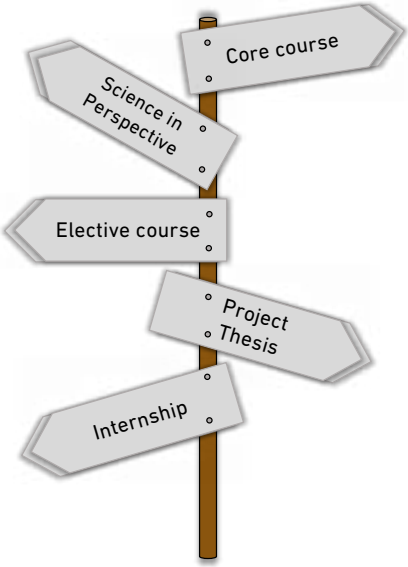
ETH zürich

Study Guide



Master of Science ETH in Materials Science and Engineering

Programme regulations 2023

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Studying Materials Science and Engineering

This brochure provides an overview of the process and organisation of the Master's degree programme in Materials Science and Engineering at ETH Zurich according to the programme regulations 2023.

1. Structure of study programmes at the Department of Materials

The Department of Materials offers a Bachelor's degree and a consecutive Master's degree study programme in Materials Science and Engineering.

The Bachelor's degree study programme focuses on solid scientific fundamentals in mathematics, chemistry and physics, the fundamentals of materials science and engineering and a thorough hands-on training. The programme lasts six semesters, comprises 180 credit points and is primarily taught in German. The Bachelor's degree allows students to continue their studies at the Master's level, be it at ETH Zurich or at another university in Switzerland or abroad.

The Master's programme in Materials Science and Engineering deepens and broadens the competences acquired in the Bachelor's programme. It generally lasts 4 semesters, comprises 120 credit points and is completely taught in English. Applications for the Master's degree programme must be submitted to the Admissions Office and are evaluated by the Department of Materials' Admission Committee.

The Master's degree forms the basis for a doctorate or entry into the job market.

2. Legal basis

This brochure is not legally binding. The current legal basis can be found in the ETH Zurich Legal Collection*:

- Study Regulations 2023 for Master's Degree Progamme in Materials Science and Engineering
- Ordinance on Admission to Studying at ETH Zurich
- ETH Zurich General Ordinance on Performance Assessment
- Directives Collection of the Rectorate

Information about current courses and the associated performance assessments are published in the Course Catalogue* of ETH Zurich.

*The course catalogue (www.vvz.ethz.ch) and ETH zurich legal collection (www.rechtssammlung.ethz.ch) are also listed online

3. Course structure

During the Master's degree programme 120 credit points are earned in the following categories:

- core courses,
- elective courses,
- courses from the Science in Perspective course programme,
- research project,
- industrial internship and
- Master's thesis.

Credit points are only awarded when the performance assessment associated with the course unit is passed.

Core courses

The core courses form the basis of the Master's degree study programme. At least 30 credit points (CP) need to be earned in this category.

The core courses are grouped around three thematic areas: dimensionally-constrained materials and phenomena, hybrid and soft materials as well as electronic and magnetic materials. Students do not need to select one thematic area, but can choose to attend courses from all of them if they wish.

All core courses are taught in English and take place on the Hönggerberg campus.

Categories	Credit points
Core courses	min. 30
Elective courses	62 - CP (core courses)
Research project	12
Industrial internship	12
Master's thesis	30
SiP Science in Perspective courses	4
Total	120

Elective courses

Around 32 credit points must be earned in the elective course category. Recommended elective courses are listed in the course catalogue. It is not mandatory to choose courses from that list. Instead, students can choose from all courses that are taught at the Master's degree level at ETH Zurich. They can either deepen their knowledge in specific subject areas or broaden their background, for example in management.

Students are encouraged to individually create a curriculum tailored to their interests. A list of courses for specific subject areas is published on the department website. Since the choice of courses is enormous, it is recommended that students take enough time to plan their Master's degree studies. Please contact the study coordinator if you require additional advice.

The total number of credit points earned in the core and elective course categories is 62 CP. If more than 30 credit points are earned in the core course category, correspondingly fewer have to be earned in the elective course category.

SiP Science in Perspective courses

Science in Perspective courses are an integral part of the curriculum at ETH Zurich. They enable students to develop new perspectives on their core subjects by addressing the historical, moral, legal, economic or political contexts. All courses that are eligible in this course category can be found in the course catalogue under the section SiP Science in Perspective. Four credit points need to be earned from this extremely broad selection.

Industrial Internship

For students starting their studies in HS 2023 or after, the industrial internship is a compulsory part of the Master's degree programme and must be carried out in a materials science and engineering environment in Switzerland or abroad.

The organization of the internship is in the responsibility of the student, which allows them to choose an internship that meets their interests and needs. It must have a minimum duration of the equivalent of 12 weeks full-time work and can be extended voluntarily.

In order to obtain the credit points, students must submit a final report together with a copy of the job reference letter or an employment certificate. More details can be found in the industrial internship guidelines on the website.

The elective courses are also listed online: www.mat.ethz.ch/studies/master/elective-courses.html

Research project

All students must complete a research project of the equivalent of 8 weeks full-time work as a preparation for the Master's thesis. During the research project, students support the work of a research group at ETH Zurich, thereby enhancing their laboratory skills and deepening subject-specific knowledge, but also contributing actively to state-of-the-art research.

Students may work on a project part-time during the semester in parallel to attending courses, or they may complete a project full-time in the lecture-free period. If fewer than five days per week are dedicated to the project, the duration of the project is extended in a way that the total working time amounts to eight weeks.

The research project is not graded and can be carried out in every research group at ETH Zurich that offers projects related to materials science and engineering, so not only groups of the Department of Materials, but also other departments at ETH Zurich.

Master's thesis

The Master's thesis concludes the Master's degree programme. It constitutes a six-month, full-time project aimed at advancing the ability of students to work independently and creatively toward the solution of a research problem under the supervision of a professor. The Master's thesis generally takes place during the entire 4th semester of the Master's degree programme and must be supervised by a professor of the Department of Materials or an associated professor.

4. Core courses

Thematic area: hybrid and soft materials

Soft Materials Engineering and Characterization (327-1207-00, autumn semester)
In this course, we discuss engineering aspects of soft materials. First, we cover different classes of soft matter systems, e.g. suspensions, gels, emulsion and foams, and introduce scaling principles to design their structural, mechanical and functional properties. Second, we cover essential characterisation techniques to interrogate the structure-property relations in soft materials.

Biological and Bio-Inspired Materials (327-1221-00, autumn semester)
This course explores the mechanisms that govern the adaptive functions of out-of-equilibrium systems in living organisms at the molecular scale and the microstructural design principles of biological materials at larger length scales. Throughout the course, we will also explore how these design principles can be incorporated into synthetic systems to improve targeted functions.

Chemistry of Soft Materials (327-1206-00, spring semester)
This course will cover the basic links between organic and polymer chemistry, state-of-the-art polymerization methods in industry and academia (e.g materials each method can synthesize), the synthesis of complex materials, chemical recycling of polymeric materials (chemistry, engineering, thermodynamics), polymeric nanoparticles (effect of shape on properties & applications and polymer elecronics.

Synthesis and Assembly of Building Blocks (327-1203-00, spring semester)
Introduction to commonly used wet chemistry methods for the synthesis of inorganic and polymeric particles of defined sizes and shapes, and concepts for assembling these building blocks into larger structures of varying complexity over multiple length scales.

The core courses are also listed online: www.mat.ethz.ch/studies/master/core-courses.html

Transport Phenomena: A Modern Approach to Coupled Transport Problems (327-1201-00, spring semester)
This course starts with the rigorous vectorial/tensorial formulation of the balance equations for mass, local species mass (including charged species), momentum, and energy, including simple constitutive equations for the fluxes (Fick, Fourier, Newton). Someselected example introduce you to scaling analysis, analytical and hands on numerical solution methods, which aim to bring physical intuition.

Dimensionally-constrained materials and processes
Surfaces and Interfaces I: Fundamentals, Analytics and Applications (327-0505-00, autumn semester)
This course teaches the basics of surface and interface science and technology, including surface modifications and forces. It covers various analytical techniques to study surface and interface properties, and explores phenomena of applied relevance like friction, lubrication, phoresis, and wetting where surfaces play a crucial role.

Thin Film Technology – From Fundamentals to Oxide Electronics (327-2210-00, autumn semester)
We will give an introduction to thin films deposition techniques and applications with a focus on the growth of multifunctional oxide thin films. The leading deposition routes (PVD and CVD techniques) and characterization techniques for application-relevant thin films will be discussed. Emerging oxide electronics, materials selection and energy efficient device concepts will be introduced.

Electron Microscopy in Materials Science (327-0703-00, autumn semester)
A comprehensive understanding of the interaction of electrons and ions with condensed matter and details on the instrumentation and methods designed to use these probes in the structural and chemical analysis of various materials.

Surfaces and Interfaces II: Materials-related Electrochemistry, Chemical Reactivity and Applications (327-2205-00, spring semester)
Introduction to fundamentals of (electro)chemical surface processes on conducting materials: reactivity, degradation, functionalizing and deposition. Relevant corrosion/oxidation mechanisms are presented along with suitable characterizations (focus: electrochemical & surface analytical methods) and practical data analysis. Growth and characterization of (thin film) metal oxides are also addressed.

Size Effects in Materials (327-2202-00, spring semester)
The core of this course explains how the behavior of materials changes, when their external dimensions become small (usually on the micro- to nanometer length scale) until quantum effects become dominant. This is illustrated by examples from all materials classes and further substantiated by case studies of applications ranging from micro- and nanoelectronics to optoelectronics.

Electronic and magnetic materials
Introduction to Magnetism (402-0535-00, autumn semester)
This course tackles the fundamental question of why only a few materials exhibit magnetism in Nature. The origin of atomic magnetic moments and the key mechanisms that govern their interactions are justified starting from fundamental principles. In addition, the influence of thermal fluctuations on magnetic ordering is discussed as well as the formalism to describe magnetic resonance phenomena.

Order in Materials (327-2208-00, autumn semester)
The aim is an overview of the different ordering phenomena that occur in materials: magnetic, electrical, mechanical, structural. Special emphasis is placed on a comprehensive definition of the term «ferroic». Novel forms of order, such as multiferroicity, are of particular interest. Their exploration and the material functionalities derived from these are a central theme in our Department.

Disorder in Materials (327-2209-00, spring semester)
The course presents structure-property relationships in complex materials, such as metallic glasses and other disordered materials, magnetic spin ice, and chemically disordered crystals.

Computational Multi-Scale Modeling of Solids (327-2143-00, spring semester)
This course considers the multi-scale computational modeling of hard-matter systems, with an emphasis on the physical phenomena of matter transport and emergent macroscopic mechanical properties, and how their microscopic origin is coarse grained to the engineering scale of a material component.

5. Student exchange (Mobility)

It is possible to obtain a maximum of 40 CP at a university or research institute other than ETH Zurich as part of the Master's degree programme. Core courses must be completed at ETH Zurich. Master students that obtained their Bachelor's degree from ETH Zurich can earn credit points in all other course categories during student exchange. All other students may carry out the Master's thesis abroad. Additional requirements are listed in the department's guidelines for student exchange that can be found on the D-MATL website*.

All plans for student exchange must be discussed with the department's Mobility Advisor, Prof. Andrei Gusev. He is also available for general requests.

6. Admission

Applications need to be submitted to the Rectorate's Admissions Office. Detailed information about the application process and the application form can be found on the website of the Admissions Office*.

Students applying for the Master's degree programme in Materials Science and Engineering may be asked to fulfill additional requirements, depending on the scope of their Bachelor's degree courses. Those additional requirements are usually courses of the Bachelor's degree curriculum in Materials Science and Engineering. The time span to fulfill additional requirements is 18 months at the maximum, possible exam repetitions included. If, after 18 months the conditions have not been met, the student will be ex-matriculated automatically and inevitably.

There is one main application period for applicants from all universities (usually Nov 1st - Dec 15th) and another one for applicants with a Swiss Bachelor's degree (usually April 1st - 30th). A non-refundable application fee is charged.

Outstanding applicants can apply for the Excellence Scholarship & Opportunity Programme (ESOP).

More information:

- Requirement profile for Master's Degree Programme*
- List of required application documents*
- Information on scholarships for outstanding students*

*For more information visit www.mobilitaet.ethz.ch or the website of the department www.mat.ethz.ch/studies/student-exchange

7. What you also need to know

The academic year

The academic year at ETH Zurich is divided into two semesters of 14 weeks each. The Autumn Semester runs from mid-September to the end of December (calendar weeks 38 to 51) and the Spring Semester lasts from mid-February to the end of May (weeks 8 to 22). There are usually no courses during the week after Easter. Until the fourth week of the semester students can register for course units.

Performance assessments

ETH Zurich distinguishes between end-of-semester exams, session exams and semester performances. End-of-semester exams take place in the last two weeks of the semester or the two subsequent weeks of the semester break. In autumn semester this means that the exams may take place in the two weeks before Christmas or the two first weeks of January. Session exams take place during the examination session in winter (calendar weeks 4 to 7) or summer (calendar weeks 32 to 35). Semester performances are other forms of assessments that take place outside the exam periods. The type of exam with which the individual lectures are assessed can be found in the descriptions in the ETH course catalogue.

Students register for and deregister from end-of-semester or session exams in myStudies. There are clearly defined time windows during which students can register or deregister. The Examination Office of the Rectorate is responsible for examination planning.

A failed performance assessment can be repeated once. If someone is registered for an exam and does not appear, this exam is considered as first attempt and «failed». Passed performance assessments cannot be repeated.

Academic calendar

All dates and deadlines for students are published in the academic calendar*.

Course catalogue

All important information regarding courses, course content and performance assessments are published in the course catalogue* (VVZ). The course catalogue for the next semester is generally published in calendar week 20 (for HS) and in calendar week 46 (for FS). The information published in the course catalogue is binding once the semester has started.

*The links can be found in the online version of this study guide or can be accessed via the following website: www.admission.ethz.ch

MyStudies

myStudies* is the central web application for students with which they can administratively manage their studies. This includes, for example, semester enrolment, enrolment for courses, exam registration, retrieval of the performance overview or the application for the diploma.

Tuition and semester fees, scholarships

The tuition fee at ETH Zurich* is currently CHF 730 per semester. The tuition fee covers the enrolment in all courses. Additionally, a compulsory semester fee of CHF 74.00 must be paid by every student. It is primarily the responsibility of students and their families to cover the study expenses. ETH offers limited scholarships* for study and living costs and a specific scholarship for excellent students on the Master's level.

*The links can be found in the online version of this study guide or can be accessed via the following websites: ethz.ch/services/en/news-and-events/academic-calendar and www.vvz.ethz.ch

8. Further information

Further information for international students

The International Student Support at ETH Zurich* is the first contact point to get any information about studying at ETH Zurich and living in Switzerland. They also issue a detailed handbook for international students*.

ETH Zurich International Student Support
+41 44 632 20 95
internationalstudents@ethz.ch

Further information about the Master's degree programme in Materials Science and Engineering

For all information concerning the Master's degree study programme in Materials Science and Engineering please contact the study administration of the Department of Materials.

Study Administration D-MATL
HCP F 33.1
Leopold-Ruzicka-Weg 4
8093 Zürich
+41 44 632 25 20
studieren@mat.ethz.ch

*The links can be found in the online version of this study guide or can be accessed via the following websites: mystudies.ethz.ch and www.ethz.ch/en/studies/financial

Contact

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